

## Training of future policeman for the use of unmanned aerial vehicle in professional activities

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### ABSTRACT

The article is devoted to the study of the issue of training future police officers to use unmanned aerial vehicles (UAVs) in their professional activities. Based on the results of the theoretical analysis of scientific and applied works, modern trends in the development of drones in the activities of law enforcement agencies were identified, and the problem of their implementation in practical activities was outlined. An online survey was conducted in order to study the opinion of scientific, scientific and pedagogical workers and graduates of higher education institutions with specific learning conditions that train police officers about the need to train future police officers in the control of UAVs. The need to introduce into the system of primary professional training the training of service skills using drones is substantiated. On the basis of the study of the content of the training program for unmanned aircraft systems of the first class according to the basic qualification level of the first level, it is proposed to introduce the general professional educational unit "formation of skills and skills of controlling an UAV" into the training program of the primary professional training of police officers in the specified specialty.

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## 1. INTRODUCTION

Today, unmanned aerial vehicles (UAVs) are an integral part of the modern world and largely determine the further development of science as a whole. The constant introduction of the latest technical means and automated systems has become inherent to law enforcement agencies [1]. Among such innovations, one of the priority places is occupied by unmanned aviation complexes, which include UAVs. In view of the functionality and versatility of the possibilities of using UAVs, it should be noted that scientists and practitioners have jointly formed certain practical recommendations and theoretical provisions regarding the implementation of UAVs in the work of law enforcement agencies. The vast majority of central executive bodies and their structural divisions, which are under the control of the Ministry of Internal Affairs of Ukraine, currently have successful experience in the use of UAVs. Among them are the State Border Service of Ukraine, the National Guard of Ukraine, the State Emergency Service of Ukraine and, of course, the National Police of Ukraine. The needs of the listed state entities are met thanks to diversity in approaches to the technical implementation of UAVs, their design, equipment and other characteristics.

One of the main types of use of UAVs by the National Police of Ukraine is the use of these aircraft for photo and video recording, video broadcasting and surveillance [2]. However, despite the presence of a

significant theoretical base on the researched issue, in scientific practice to date there are no thorough studies and proposals regarding training and training of future police officers to use UAVs in their professional activities. Investigate the need for training police officers in the management of UAVs based on the conducted research, taking into account the specifics of the functional responsibilities of police units, in order to effectively and professionally master the skills and abilities of police officers to perform duties with the help of UAVs, to propose appropriate additions to the training program of the primary professional training of employees of the National Police of Ukraine.

## 2. LITERATURE REVIEW

A significant number of fundamental and scientific and applied works by foreign and Ukrainian scientists are devoted to the problem of the use of UAVs in law enforcement activities, in particular by the National Police of Ukraine. The procedure for planning the rational use of reconnaissance UAVs during the execution of tasks to stop mass riots by the National Guard of Ukraine has been considered [3]. Movchan and Movchan [4] studied the organizational and legal principles of the use of UAVs in the activities of law enforcement agencies. In the article “history, current state, and prospects of development of UAVs as a technical and forensic tool and object of forensic research,” the authors highlighted the modern possibilities of using UAVs by police bodies and units, outlined certain problematic issues that need to be resolved and, based on international experience, identified directions for improving the current legislation on the use of UAVs by the National Police of Ukraine [5].

The issue of the effectiveness of UAV-assisted real-time evidence detection during the inspection of a crime scene in an open space by watching a live video broadcast from a drone by an operator in real-time was investigated in the articles “UAV-assisted real-time evidence detection in outdoor crime scene investigations” and “use of UAVs in crime scene investigations—novel concept of crime scene investigations” [6], [7]. A comparative analysis of search methods using UAVs and traditional search methods by simulating a crime scene survey for evidence indicates that the use of drones for evidence can provide increased accuracy and speed of detection in different types of terrain. The author's team conducted a research review of the use of UAVs in various forensic events, including the detection of secret graves, investigation of crime scenes and traffic accidents, assistance in the event of a natural disaster and detection of pollution, and a wide range of capabilities of drones in forensics was determined [8].

To prevent accidents at railway pedestrian crossings, representatives of Silla University (South Korea) researched the latest convolutional neural network models and algorithms suitable for building a modern system for detecting pedestrians on railways using UAVs [9], [10]. Kim and Lee [11] proposed a reconnaissance method for detecting and identifying violations of traffic rules using UAVs, which consists in a new approach to detecting violations of traffic rules using drones, taking into account the coordinates of continuous lanes, bus lanes, and roadsides, as well as identification of vehicles and their license plates. It should be noted that such a question as the initial professional training of police officers has been studied by many scientists, such as: Beschastnyi, Veselov, Pylypenko, and Atamanenko *et al* [12]–[14]. In particular, the research on the impact of police bodies and units on road safety deserves attention; models of training law enforcement officers for professional self-realization and the effectiveness of the introduction of simulated situational tasks in the original method of forming the professional competence of modern police officers [15]–[21]. However, despite the thorough and complex scientific and technical base, many issues remain debatable, including the need to train the National Police of Ukraine to operate UAVs.

## 3. RESEARCH METHOD

An online survey was conducted using Google Forms in order to study the opinion of scientific, scientific and pedagogical workers, and graduates of institutions of higher education with specific training conditions that train police officers regarding the need to train police officers in the management of UAVs. Among the surveyed respondents, 4374 (92.7%) were graduates of higher education institutions, 345 (7.3%) were scientific and scientific-pedagogical workers. The results of the answers provided by users to the question proposed in the questionnaire regarding the units of the National Police of Ukraine, in which there is a need to use UAVs, were divided as follows:

- The majority of respondents (56.1%) believe that special purpose police units should primarily use UAVs.
- 35.0% of survey participants note that in modern conditions, all police units should be equipped with UAVs.
- 3.8% of respondents do not consider it necessary to use UAVs in units of the National Police of Ukraine.

Survey participants positively assess the necessity of UAV control training in the professional training system, 4142 (87.8%) respondents voted “yes”, 577 (12.2%) voted “no”. To the question about the

introduction of UAV control training into the professional training system, the respondents had the opportunity to choose several answer options, but most of them consider it more appropriate to introduce UAV control training in educational institutions, both during initial professional training and during higher education as shown in Figure 1. The largest number of interviewed graduates of higher education institutions believe that it is appropriate to introduce training in the management of UAVs in higher education institutions with specific training conditions (46.2%) and during initial professional training (35.8%). The opinion of the surveyed scientific and scientific-pedagogical workers is somewhat different, some support the opinion of the applicants regarding training in higher educational institutions with specific training conditions (3.3%), others certified courses of UAV pilots outside of the professional training of police officers (3.8%) as shown in Figure 2.

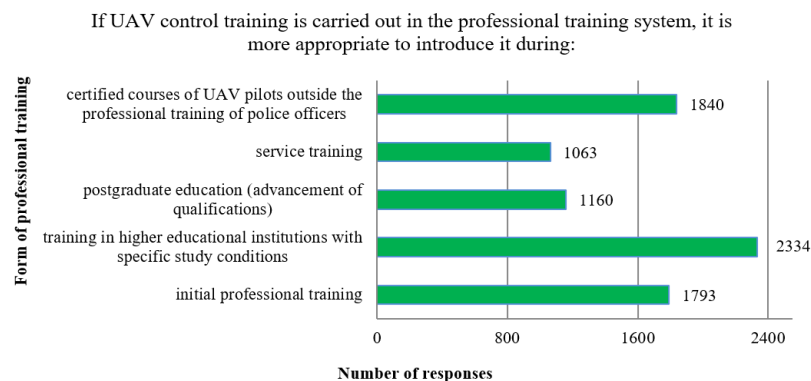


Figure 1. The results of processing the online survey

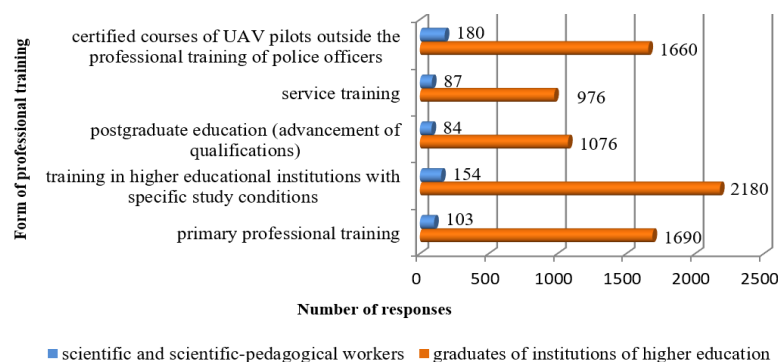


Figure 2. Distribution of answers by categories of correspondents

#### 4. RESULTS AND DISCUSSION

Today, UAVs have revolutionized the world of aviation and become an invaluable tool for both commercial and recreational use. Drone technology is constantly developing and improving, which positively affects the work of many enterprises and government organizations, including agriculture, construction, monitoring of the earth's surface, art, search and rescue [22], defense and security. At the same time, taking into account the situation that has developed in connection with Russia's military aggression against Ukraine, UAVs have become an integral part of the armed forces of Ukraine (AFU). Due to the ability to remotely control the device, fly at different distances and altitudes, the UAV is an ideal candidate for combat missions such as surveillance, reconnaissance of enemy positions, and adjusting artillery fire [23]–[25].

Unfortunately, for a long time, work on the development of UAVs in Ukraine was carried out mainly on a theoretical level, since the term of acceptance into operation of new weapons and equipment reached approximately 2 years. However, today's realities contributed to shortening the terms to 3-5 weeks, which allowed Ukrainian companies to increase the production of drones for the needs of the AFU in a geometric progression. Currently, the AFU uses on the battlefield not only the most famous Turkish combat drone – Bayraktar Taktik Blok 2 (TB2), products of the Chinese company dajiang innovation technology Co (DJI) and the American company autel robotics [26], but also 28 UAV models of its own production, including: A1-SM “Furiya” (modification of the Ukrainian unmanned aerial reconnaissance complex and

adjustment of artillery fire), Raybird- 3, PD-2 (People's Drone), Leleka-100, RAM II UAV (modification of the Ukrainian kamikaze drone), Punisher, Sirko and "Gor".

Today, as the Minister of Digital Transformation, Mykhailo Fedorov notes, "Ukraine is on the way to becoming a world leader in the production of drones. After all, each of these drones was not just tested on some training ground, it was tested in the conditions of a real war". However, it should be noted that UAVs are used not only for military purposes.

Today's big step with revolutionary potential is the use of UAVs in the activities of law enforcement agencies, which according to Article 2 of the Law of Ukraine "On the National Police" dated July 2, 2015 No. 580-VIII [27] provide police services in such areas as: i) ensuring public safety and order; ii) protection of human rights and freedom, as well as the interests of society and the state; iii) combating crime; and iv) providing assistance services to persons who, for personal, economic, social reasons or as a result of emergency situations, need such assistance within the limits defined by law. Currently, two draft laws have been considered "on amendments to some legislative acts of Ukraine regarding the use of UAVs by law enforcement agencies and countering their illegal use" [28] and "on amendments to the code of Ukraine on administrative offenses regarding the establishment of liability for violation of the order and rules of use of the airspace of Ukraine by operators of unmanned aircraft" [29]).

In detail, project no. 8185 [28] is aimed at maintaining public safety and order, protecting people's lives and health, protecting the state border, critical infrastructure facilities, and important state facilities from threats arising from illegal using UAVs. An important aspect is that certain provisions of the draft law provide for the expansion of the powers of law enforcement agencies, which is the basis for creating an effective system for countering threats of terrorist acts (sabotage) with the help of UAVs, as well as ensuring regulation in the field of operation of civilian UAVs through the adoption of appropriate aviation rules. In turn, project no. 8186 provides for administrative responsibility for violations of the order and rules of use of the airspace of Ukraine by operators of unmanned aircraft. So, with the help of drones, law enforcement agencies can quickly respond in real time, conduct aerial surveillance, track a stolen vehicle or find the person driving it. In other words, drones can help law enforcement agencies track suspects who break the law, and improved situational awareness opens up a wide range of functions for police officers that may have previously seemed impossible [30]–[33].

However, it should be noted that at the legislative level, the issue of the process of mastering special skills and UAV control skills, necessary for the performance of the tasks assigned to police units, remains unsettled. At the same time, the training of UAV operators for the needs of the Armed Forces is currently carried out within the framework of the "Army of Drones" project, which was initiated by the joint efforts of the General Staff of the Armed Forces and the Ministry of Digital. The mentioned project provides for the acquisition of control skills of conventional reconnaissance copters (mavic/matrice/autel), FPV drones and bomber aircraft (Leleka, FlyEye). Training is carried out within the framework of the signed memorandum of cooperation with 26 private schools located in different parts of Ukraine. The training course consists of theoretical and practical parts. The theoretical part of the training includes the study of the technical parameters of drones, equipment maintenance, cartography, flight tactics in the conditions of electronic warfare (EW), camouflage, and unmasking factors of the enemy; practical training is characterized by flying on training grounds and performing missions that are as close as possible to real combat. In order for the employees of the National Police of Ukraine to effectively and professionally master the skills and abilities of service with the help of UAVs, it is advisable to investigate the issue of initial professional training of police units.

According to Article 73 of the Law of Ukraine "On the National Police" dated July 2, 2015 No. 580-VIII [28], police officers who are first recruited into the police service, in order to acquire special skills necessary for the performance of police powers, are required to undergo initial professional training according to the relevant educational programs (plans) approved by the Ministry of Internal Affairs of Ukraine. For cadets (students) who entered training from among civilians and obtain higher education on a full-time basis under the state order in institutions of higher education with specific conditions of study, which train police officers, the relevant programs (plans) of initial professional training provide educational subjects (disciplines) are included in educational programs for each specialty of their training and are studied in the first year. The initial training of police officers in the profession 5162 "policeman" is carried out in accordance with the requirements of the state standard of vocational (vocational and technical) education, approved by the order of the Ministry of Education and Science of Ukraine dated June 21, 2018 No. 669 [34] according to the relevant specializations and qualifications: patrol officers policemen (policemen of response sectors of the patrol police); operatives of the criminal police; investigators (investigators) of pretrial investigation bodies; police officers of preventive activity units (district police officers, juvenile prevention officers); policemen of security units (logistics units, policemen of convoy units, policemen of temporary detention centers).

Training of police officers commissioned by the National Police of Ukraine is carried out by institutions of higher education with specific training conditions or institutions (institutions, centers) of the National Police of Ukraine and is based on a competency-based approach and is structured according to the modular principle. The structure of the training module includes a list of general professional competencies (GPC) that are mastered within 6 months or during the first year of study: mastering the basics of constitutional law (GPC-1); compliance with the requirements for ensuring the rights and freedoms of a person and a citizen (GPC-2); mastering the basics of anti-corruption legislation (GPC-3); mastering the basics of professional ethics (GPC-4); observance of tolerance and non-discrimination in the work of a police officer (GPC-5); mastering the basics of effective communication (GPC-6); formation of stress resistance (GPC-7); mastering the basics of effective interaction with the population on the basis of partnership (GPC-8); compliance with the requirements of the legislation on the prevention and counteraction of domestic violence (GPC-9); mastering the knowledge of the traffic rules (GPC-10); compliance with legislation on occupational health and safety (GPC-11); mastering the legal and organizational foundations of the National Police of Ukraine (GPC-12); mastering the basics of document management in official activities (GPC-13).

After completing the training, a person who has mastered the educational program and successfully passed the state qualification certification is assigned the educational and qualification level "skilled worker" in the profession "Policeman (by specialization)" and is issued a document of the established model, with which the policeman returns to the authorities (institutions, institutions) to the police for further service in the police in accordance with the law. Examining the typical training programs of the educational components separately, we can come to the conclusion that they do not have a single component dedicated to the mastering by police officers of the skills and abilities of performing duties using UAVs. Based on the above, there is a need to supplement the training program of the primary professional training of police officers with the training program of unmanned aircraft systems of the first class according to the basic qualification level I (BQL I) [35].

The training course for external UAV pilots (operators), which consists of a theoretical and practical training program, is the basic foundation for the formation of professional competencies due to the new requirements for law enforcement officers. Theoretical training is equivalent to the training of manned aircraft crews, which in turn includes the acquisition of basic knowledge, namely: the structure and procedure for using the airspace of Ukraine; air traffic control procedure and flight rules; aerodynamics (practical aerodynamics); construction of an unmanned aircraft complex (UAC); flight and technical operation of UAC; air navigation; aviation meteorology; the procedure for conducting radio communication (including in aviation English (international civil aviation organization (ICAO), level 4)); performance of combat (special) tasks; flight safety. Practical flight training consists of flight training at the UAC and training at the UAC training and simulation complex. Flight training provides external UAC pilots (operators) with the opportunity to demonstrate the skills and abilities to operate a UAC (UAV, remote piloting point (PRP)) in its entire range of altitudes and speeds, including actions in special cases in flight (SCF) at any stage flight.

BQL I, in turn, it includes preparation for the performance of a combat (special) task, direct preparation and performance of the flight, requirements for instructors and testers.

- The order of preparation for the execution of a combat (special) task: i) general preparation: aviation meteorology; tactical and technical data (TTD) and UAC restrictions; the structure of the airspace of Ukraine (flight area), aeronautical information documents; governing documents on the organization, conduct of flights, and use of Ukrainian aircraft; use of flight and topographic maps; selection of flight routes in accordance with the conditions of the task; drawing up a navigational flight plan; execution of navigational flight calculations manually; execution of engineering and navigation calculations of the flight; actions in SCF; flight planning (UAV departure and arrival); use of computerized flight planning systems; clarification of the flight task (combat, navigation orders); management of crew actions; ii) communication: the procedure for organizing communication and control transfer boundaries between ACP (aviation control point); functioning and procedure for using on-board communication systems; functioning and procedure for using data transmission lines; iii) UAC operation: aerodynamics and flight dynamics (practical aerodynamics); operation of navigation systems; detection and avoidance of dangerous weather phenomena; features of flights at low and extremely low altitudes; actions with PRP equipment in emergency situations (actions in SCF); actions with PRP equipment during manual control of the UAV; UAC flight operations manual (FOM).
- Direct preparation and execution of the flight: i) pre-flight preparation: setting the task for flights; study of flight tasks; study of weather conditions; flight planning according to visual flight rules (VFR); selection of the main and reserve routes; selection of flight altitudes on the route based on aeronautical data; preparation of flight (topographic) maps; performing a UAC pre-flight check; performing an external UAC audit; verification of relevant communications (communication and command line); a note in the UAC preparation log about UAC readiness; performing a check of PRP device readings; performing a

- compliance check of GPS readings; obtaining relevant flight restrictions and permits; carrying out a check of readiness for take-off; ii) flight performance: take-off, climb at control points (exit to control points); setting a given flight speed; setting and maintaining a given flight height; performing a UAC system check after takeoff; compliance with the given UAV flight mode; guidance in flight; using a map for orientation; execution of maneuvers in the given zone (district); obtaining permission to perform the task in the zone (district); setting the specified speed, course, height in the zone (area); flying at low speed; execution of basic (set) evolutions in flight (turns, descents, and climbs); execution of removal from a difficult position; execution of removal from the landfill; recovery of lost flight control (UAV control); taking the starting position and checking the UAC systems before lowering and leaving the zone (area); execution of descent and exit from the zone (district); departure to the starting point of the maneuver for the landing approach; analysis of wind direction and speed; execution of the landing approach according to the established schemes; observance of safe echeloning; due diligence at all stages of the flight; transfer and control of the UAV in the landing configuration; performing an approach from the border (approach from a straight line); performing a descent along the glissade; take-off and landing in automatic mode; landing; running; taking off from the conveyor; execution of departure to the second circle in case of an error during the approach; execution of the departure to the second circle from the height of decision-making; execution of departure to the second circle from the leveling height (on command); performing procedures and checks after landing; demonstration of flying skills while operating a UAV (situational analysis and decision-making literacy); demonstration of competent work with PRP management bodies; demonstration of compliance with the sequence of flight tasks; iii) flight according to instrument flight rules (not applicable); iv) air navigation: performing visual orientation; performing card reading; determination of visual landmarks; comparing the location of the UAV with the map; calculation of actual fuel consumption (battery charge); performing navigator calculations in flight; determination of corrections taking into account the wind in flight; calculation (clarification) of landing time; control over fuel consumption in flight; performing procedures in case of loss of communication and/or failure of the data transmission line; v) emergency situations: detection of emergency situations; analysis of the situation and implementation of appropriate actions in the SCF; making a report on the SCF (submitting the “Trouble” signal); checking the functionality of systems during SCF; performing continuous control of the UAV during SCF; execution of emergency boarding; vi) post-flight procedures: performing specified checks after landing; performing specified checks after engine(s) shutdown; implementation of measures to protect (protect) UAC after the flight; execution of specified procedures after landing (in accordance with the FOM); making appropriate entries in the UAC training log; filling out flight documentation.
- Requirements for instructors and testers: demonstration of understanding of training methods; demonstration of theoretical teaching methods; demonstration of practical training methods; demonstration of flight skills in the field of tests; demonstration of awareness of the sequence of execution of the test plan; performance of systems testing procedures; analysis of test data.

So, police officers have to go through a full theoretical and practical training program, pass an exam and pass, after which they will receive certificates and flight books of an external UAV operator. The formation of competences by the means of training UAV operators according to the training program of UACs of the first class according to BQL I is too overloaded for the needs of law enforcement agencies. According to the authors, in order to perform their official duties, it is enough for law enforcement officers to master the general professional training unit “formation of UAV control skills and abilities,” which can be included in the training program of the initial professional training of police officers as shown in Table 1. Therefore, the high-quality mastery of the primary professional training curriculum by the National Police of Ukraine, with the proposed additions, will enable each of them to perform their own functional duties with the help of UAVs at a high professional level and will allow them to acquire additional general professional competence regarding the use of UAVs in official activities.

Table 1. Content of general professional competences – formation of UAV management skills and abilities

General professional competences	Content of general professional competences
Formation of abilities and skills of UAV control	<p><i>Know:</i> the legal basis for the use of UAVs in the airspace of Ukraine; basics of meteorology; the main components of the UAV design; peculiarities of the use of filming equipment; methods of flight preparation and execution; principles of flying within the visible limits and beyond the limits of direct visibility.</p> <p><i>Be able to:</i> perform UAV assembly; start correctly, switch to autopilot mode, avoid obstacles, quickly apply appropriate actions in case of extreme situations; apply knowledge of safety rules; correctly configure the payload; use a thermal imager; monitor technical indicators during flight control; navigate by topographic maps, Google maps and terrain; carry out photography and video recording of events in the area; process the received photo and video materials; perform maintenance on the UAV.</p>

## 5. CONCLUSION

The primary professional training of police units of the police is a necessary and integral element of their high-quality and effective performance of functional duties related to the fulfillment of the tasks of the National Police of Ukraine. However, in order to be able to effectively perform duties while on duty with innovative technologies such as UAVs, it is necessary to complete initial professional training with appropriate additions. The prospects of further research are connected with the study of the possibility of using UAVs in the registration of traffic accidents, with the addition of the initial professional training of police units according to the training program of the profession “policeman” of the qualification “patrol policemen (policemen of the response sectors of the patrol police)” with the general professional training unit “formation of skills and skills of road accident registration using UAV.”

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